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Report Series

Implementation Plan
Management
and Technical
Support Activities



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National PDES Testbed



Implementation Plan Management and Technical Support Activities

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Preface

This document describes a plan to implement a number of different management and technical support activities for the CALS/PDES Project at the National Institute of Standards and Technology (NIST). CALS is the acronym for "Computer-aided Acquisition and Logistic Support." PDES is the acronym for "Product Data Exchange using STEP." The activities described in this document are an integral part of the overall project to establish the National PDES Testbed at NIST. The Testbed was initiated in 1988 under the sponsorship of the U.S. Department of Defense CALS Program. A major goal of the Testbed is to provide technical leadership in a national effort to implement a complete and useful specification for the exchange of product data. This specification must be designed to meet the needs of American industry and agencies with the Federal government, in particular, the Department of Defense CALS Program.

The National PDES Testbed supports and actively participates in the international effort to develop the Standard for the Exchange of Product Model Data (STEP). The STEP development effort is led by the International Organization for Standardization (ISO) Technical Committee on Industrial Automation (TC184) Sub-committee on Industrial Data and Global Programming Languages (SC4).

This plan describes one of several project threads that have been established for the National PDES Testbed. Other threads address such areas as:

- development of configuration management systems and services,
- construction of a validation testing system to evaluate application protocols,
- specification of candidate STEP application protocols,
- construction of a prototype STEP-based manufacturing cell,
- establishment of the Product Data Exchange Network, and
- establishment of a conformance testing service.

The level of support provided for these threads and others will be determined by sponsor needs and a number of different priorities. As such, the implementation plan contained within this document outlines a reasonable schedule to accomplish the objectives of the thread. Changes in priorities and levels of support may either accelerate or delay the proposed schedule. This plan will be updated periodically to reflect technical changes in the project, current level of effort, and expected continued support.

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Executive Summary

The National PDES Testbed is just one small, but critical, component of a larger international effort to develop product data exchange capabilities. As such, Testbed efforts must be coordinated with other organizations. The Management and Technical Support Activities (MTS) thread provides a mechanism under which a variety of activities will take place. The thread will run for the duration of the Testbed project.

The goal of this thread is to establish a focused effort for critical management and technical support activities which will advance the development of product data standards and related technologies. The principal objectives of this effort are:

- development of management and technical plans for the CALS/PDES Project and the National PDES Testbed,
- coordination and synchronization of activities with other organizations,
- establishment of stable Testbed facilities and systems, and
- transfer of product data standards technologies to other organizations.

The development of product data standards and related technologies is a cooperative international venture which involves representatives from many different organizations. The international "Standard for the Exchange of Product Model Data", commonly called STEP, is the focal point for this venture. The International Organization for Standardization (ISO) Technical Committee on Industrial Automation (TC184) Subcommittee on Industrial Data and Global Programming Languages (SC4) has ultimate responsibility for the development of the STEP specifications. Some of the other organizations which are supporting the effort include: the IGES/PDES Organization (IPO), PDES, Inc., and the National PDES Testbed. The IPO is the U.S. national activity which is supporting "Product Data Exchange using STEP" (PDES). PDES, Inc. is an industrial consortium of more than twenty corporations and government agencies which is dedicated to accelerating the development of STEP. The National PDES Testbed, which is located at the National Institute of Standards and Technology (NIST), is working to establish a testing-based foundation for the proposed standard. The National PDES Testbed is sponsored by the U.S. Department of Defense Computer-aided Acquisition and Logistic Support (CALS) program. All of these organizations are working closely together to develop the STEP specifications.

The Management and Technical Support Activities technical thread is a major element of the CALS/PDES Project at NIST. It is different from the other technical threads of the project in that it is comprised primarily of ongoing or recurring activities. Some examples of the activities included in this thread are: 1) establishment of planning committees to develop/maintain strategic and technical plans, 2) development of coordinated master plans with other organizations, 3) establishment of project work statements, budgets, and policies, 4) development of software quality assurance programs, 5) participation in standards and technical development activities of other

organizations, 6) administration of the Testbed as a user facility, 7) maintenance of the Testbed PDES Hotline, 8) support of global Testbed facilities, i.e. computer hardware, software, and communications systems, 8) development of training materials and programs, 9) performance of various information support, technology transfer, and public relations functions, and 10) establishment of internal and external review boards for the Testbed project.

What outputs will result from the Testbed activities at NIST?

- Long range strategic plans, technical development and implementation plans for both activities both within and outside of NIST,
- Technical reports which cover Testbed administration, system configuration, policies and procedures, general technical information, project status, participation in standards and technical activities, training materials, etc.,
- Staff support of outside organizations, e.g. PDES, Inc., the IGES/PDES Organization, and ISO TC184 SC4 activities,
- Operational PDES Testbed facilities and systems which can be used by NIST and other organizations to develop and evaluate product data standards,
- Technology transfer activities such as: distribution of technical publications, workshops and conferences, and public demonstrations of Testbed capabilities and project results, and
- Review meetings with sponsors, outside organizations, and advisory boards to obtain feedback on the direction of technical projects.

Resources which will be required to support this thread include: management and technical staff, computer and communications equipment, software, and Testbed facilities.

This technical thread is critical to the success of the CALS/PDES Project and the National PDES Testbed. It defines management activities which will set the overall direction of the CALS/PDES Project. It is the source of coordination and support efforts with other organizations. The scope of this thread includes the maintenance and operation of the National PDES Testbed systems and facilities. It also provides for the transfer of technology, developed at NIST and elsewhere, to other organizations.

1 Goals and Objectives

The National PDES Testbed provides a major focal point for product data standards activities that are underway at the National Institute of Standards and Technology (NIST). The Testbed is a key element of the CALS/PDES¹ Project² and NIST's Manufacturing Data Interface Standards Program.

The goal of the Management and Technical Support Activities thread is to:

-- establish management, coordination and support mechanisms within the CALS/PDES Project and the National PDES Testbed which advance the development and implementation of product data standards within the Department of Defense, other government agencies, private industry, and academia.

Four objectives which lead to the attainment of this goal are:

1. Establishment of an organizational structure, long range and near term technical plans, and the initiation of project tracking mechanisms which lead to the timely and cost-conscious completion of quality deliverables for the project,
2. Coordination of CALS/PDES project goals, plans, and technical activities with programs of other organizations so as to facilitate and accelerate the development of product data standards and enabling technologies,
3. Operation and maintenance of the National PDES Testbed laboratories and systems as test and evaluation facilities for evolving product data standards, and
4. Transfer product data standards technology to other organizations, e.g., the Department of Defense, other government agencies, industry, and academia.

These objectives complement and support related objectives for the other technical threads of the CALS/PDES Project.

¹ CALS is the acronym for Computer-aided Acquisition and Logistic Support. PDES is the acronym for Product Data Exchange using STEP.

²The CALS/PDES Project is sponsored by the Department of Defense CALS Program Office. In 1990, the Department of Defense and the Department of Commerce signed a memorandum of understanding which outlines common objectives and a plan for cooperation in the CALS/PDES area.

Goals and Objectives

2 Project Overview

The National PDES Testbed, located at the National Institute of Standards and Technology (NIST), supports the goals of the IGES/PDES Organization (IPO) and International Organization for Standardization (ISO) to establish an international standard which will support product data sharing. The National PDES Testbed was established at NIST in 1988 under U.S. Department of Defense CALS program funding. Standards which support product data sharing are recognized as a major building block in the CALS program [CALS89].

Under CALS sponsorship, the National PDES Testbed supports the development of product sharing technologies not only for the Department of Defense, but also for other U.S. government agencies and American industry. The staff of the National PDES Testbed actively participate in the activities and programs of the ISO, IPO, and PDES, Inc.³ For a more detailed discussion of PDES-related activities, see [Furlani90].

This section presents an overview of each of the management and technical support activities which have been defined for the CALS/PDES Project and the National PDES Testbed. For the purposes of this overview, the support activities are:

- Management of technical projects,
- Interactions with other organizations,
- Operation of the National PDES Testbed facility, and
- Transfer of product data standards technologies.

Each activity area is briefly addressed in the sections that follow.

2.1 Management of Technical Projects

A sound management program is critical to the success of the CALS/PDES project. The CALS PDES Management Team is responsible for developing plans, initiating and tracking technical projects, ensuring the quality of project deliverables, overseeing administrative operations, and interacting with external review boards. The principal participants in the CALS/PDES Management Team are the CALS PDES Project Manager and the project managers (see Section 4 for more on the CALS/PDES Management Team). The Division Chief and the Group Leaders of the Factory Automation Systems Division of the NIST Manufacturing Engineering Laboratory also support the activities of the CALS PDES Management Team. The project operates within a matrix management organizational structure. The Group Leaders are responsible for the direct supervision of the project managers. The CALS/PDES Project is perhaps unique at NIST because it includes management and technical participants from three major laboratories

³NIST is a government associate of the PDES, Inc. industrial consortium.

within NIST. Guest researchers from industry also participate in the project on a temporary basis.

What plans have been developed for the project?

At the request of the CALS sponsor, a major focus of the CALS/PDES Management Team has been the development of near-term and long range plans. Planning efforts for STEP have been directed at the development of a strategic (10 year) plan for vehicular manufacturing, an intermediate (5 year) plan for mechanical parts manufacturing, a short range (2 year) plan for the National PDES Testbed [McLean90], and individual plans for Testbed technical threads, i.e. projects. Some of the technical threads for which plans have been developed include:

- Configuration Management Systems and Services [Ressler90],
- Validation Testing System [Mitchell90],
- Application Protocols for Mechanical Parts Production [Stark91],
- STEP Production Cell [Fowler90],
- Product Data Exchange Network [Frechette90], and
- Conformance Testing Service [Kemmerer91].

These technical thread plans are in the form of NIST technical reports. The long and intermediate range plans are more conceptual in nature. They are maintained in presentation format.

What types of deliverables does the project produce?

The National PDES Testbed is carrying out a broad range of activities in support of the development of product data standards and related technologies. Some examples of outputs of the project include:

- Technical reports on product data standards,
- Initial input and feedback to standards committees on draft standards specifications,
- Evaluations resulting from testing activities,
- Prototype software tools for testing and the development of STEP-based software applications,
- Plans for internal/external PDES activities,
- Management and technical staff support to other organizations,
- Technical consulting on standards and related technologies,
- Presentations and demonstrations at various conferences and other events,
- Reports to sponsors, and
- Educational materials to support training on product data standards topics.

The previous list is representative of the types of deliverables produced by the project, but it is by no means exhaustive.

How will management ensure the quality of project deliverables?

Within the scope of the project, the CALS/PDES Management Team is defining and refining policies, procedures, and mechanisms to help ensure the quality of project deliverables. Some examples of the mechanisms which have been established to help ensure the quality of project outputs include:

- Formal written plans for all projects,
- A computerized project tracking system,
- Quality checklists for project documents,
- An internal review process for all project deliverables,
- Configuration management systems and procedures for software developers,
- A Testbed Readiness Program to ensure the stability of Testbed systems,
- Written policies and procedures for project administration, and
- A training program for CALS/PDES Management Team,

In addition to these mechanisms which have been implemented within the project, NIST has an editorial review process which also helps ensure the quality of all publications.

As a part of this plan, CALS/PDES Management Team will establish a Technical Advisory Board (TAB) to help identify industry needs, provide guidance, and help set long term direction for the project. The TAB will include representatives from government, industry, and academia. The TAB will meet at NIST twice a year to review CALS/PDES Project technical efforts in the product data standards area.

2.2 Interactions with Other Organizations

The creation of a specification for the standard representation of product data involves many complex issues. It is virtually impossible for one individual or even a small group of individuals to just sit down and write this kind of specification. The development of this specification requires both a strong technical and institutional foundation. The technical foundation for STEP is based upon a number of different information and manufacturing systems technologies. It draws upon the experience of many technical experts. The institutional foundation for STEP is provided by voluntary technical activities, national and international standards organizations, businesses and industrial consortiums, and government agencies. STEP will be an effective standard when consensus is achieved, i.e., all of these organizations must be in general agreement about the definition of STEP.

Who are the principal players involved in product data standardization?

Three players other than the NIST and National PDES Testbed are ISO TC184 SC4, the IGES/PDES Organization, and PDES, Inc. These organizations are briefly highlighted below:

ISO TC184 SC4 - The ISO STEP subcommittee, TC184 SC4, has overall responsibility for the development of the STEP standard [ISO90-1], [ISO90-2]. TC184 SC4 is made up of representatives from 26 countries. The representatives from these countries include 18 participating and 8 observing members. The SC4 is organized into the following projects: Standard Parts, Product Modeling, Qualification and Integration, Development Methods, Conformance Testing, and Implementation Specifications. The STEP standard is currently under development and is divided into a number of parts which address: methodologies, specification formats, testing issues, information models, and application protocols. A near term goal of ISO TC184 SC4 is the establishment of a STEP Version 1.0 Draft International Standard in 1993. NIST provides the Secretariat of SC4.

IPO - "Product Data Exchange using STEP" (PDES) is the name given to the U.S. national technical activity that supports the development and implementation of the proposed international standard known as STEP [IPO90-1]. This activity is conducted by the IGES/PDES Organization (IPO). The IPO has been working since 1984 to develop information models for product data leading to a standard to support the sharing of product data between computer systems. The chair for the IPO is located at NIST. Staff from both PDES, Inc. and the National PDES Testbed actively participate in the technical activities of the IPO.

PDES, Inc. - An industrial consortium of over 20 technology companies, PDES, Inc., was established in 1988 [PDES90]. It was specifically formed to accelerate the development of PDES. The consortium supports STEP in the following technical areas: application protocol development and testing, topical model liaison, and prototype implementations. PDES, Inc. supports the CALS program goal which is to have STEP available as a standard for delivery of product definition data for weapon system acquisition and spare parts procurement. In August 1988, the South Carolina Research Authority (SCRA) was awarded the Host contract to implement the PDES, Inc. Program. NIST participates in PDES, Inc. as a government associate. A NIST representative serves on the Executive Board of PDES, Inc.

What kinds of coordination activities are required?

The development and implementation of product data standards will be accelerated if the principal organizations work together to achieve common goals. Some examples of the ways that project staff are coordinating with other organizations include:

- Establishment of memoranda of understanding and cooperative research agreements with other organizations,
- Designation of liaison staff to coordinate interactions between organizations,
- Development of integrated master plans which identify common program objectives, management and technical responsibilities, project schedules and deliverables,
- Membership on technical committees within standards and technical organizations,
- Joint participation by technical staff of multiple organizations in technical projects which are directed towards the common goal of accelerating the development of STEP,
- Establish common project management practices which facilitate the tracking and review of joint project efforts,
- Development of common configuration management systems and the establishment of uniform practices for managing the configuration of both documents and software,
- Establishment of common testing environments at other Testbed sites through the establishment of: common computing environments, mutual exchange of software and documentation, and coordinated operations,
- Publication and distribution of jointly-developed reports and other project outputs,
- Establishment of communications channels, electronic and otherwise, to facilitate the interchange of information between organizations,
- Development and implementation of common training program for the management and technical staff of cooperating organizations,

- Participation of management and/or technical staff on each other's review, and advisory committees.

In addition to working with organizations outside of NIST, project staff coordinate within NIST through participation in the NIST-wide Product Exchange Task Group. The Task Group meets regularly to discuss technical questions and establish positions on product data standards issues.

In the future, project staff will participate in other joint efforts, as appropriate, to further the STEP development, validation, and implementation processes.

2.3 Operation of the National PDES Testbed Facility

A major element of the CALS/PDES Project has been the establishment, operation, and maintenance of the National PDES Testbed. The PDES, Inc. consortium has been a major technical contributor and user of this facility.

What is the National PDES Testbed?

The National PDES Testbed is an impartial, publicly accessible facility where successive definitions of the STEP specifications can be modeled, analyzed, implemented, and tested. The Testbed facility is comprised of laboratories, computer hardware, software systems, and testing tools.

The computer facilities of the Testbed include two mainframe computer systems, more than 30 engineering workstations and personal computers, tape drives, printers, and plotters. Testbed users may access these systems locally, via telephone modems, or over publicly-accessible computer communications networks. Other supporting hardware available to the National PDES Testbed includes the shop floor equipment of the Automated Manufacturing Research Facility (AMRF) [Simpson82]. The AMRF shop floor contains machine tools, coordinate measuring machines, material handling systems, robots, and other supporting production systems. These systems provide a capability for testing product data standards in a production environment.

A number of different types of software packages are installed on these computers systems. Some of the software packages include: information modeling systems, data base management systems, computer-aided design systems, graphics tools, program development systems, word processors, and desktop publishing systems. Other software includes prototype testing tools, process planning, and programming systems for numerically controlled machine tools.

How are the Testbed facilities and systems used?

The Testbed is used and staffed by leading experts on product data standards issues from industry, academia, and government. The Testbed is currently being used by PDES, Inc. and NIST staff to evaluate portions of the STEP specification. Users of the Testbed:

- construct computerized representations of the information models that have been derived from the product representation schemes defined in the draft STEP specifications,
- evaluate the correctness and completeness of STEP information models using established analytical techniques which are accepted by industry professionals,
- define the databases that correspond to the information model, generate test data, and populate the databases with that data,
- develop comprehensive test criteria and test cases with support from industry experts which test the STEP databases with transaction scenarios that reflect "real world" requirements and operating conditions,
- review test results, document deficiencies, and recommend changes to the draft STEP specifications to relevant standards committees, PDES, Inc., and project sponsors.

As the product data standards effort moves from the development of draft specifications to approved standards, the Testbed users will initiate new activities. Users of the Testbed will:

- support the development and evaluation of validation and conformance testing systems,
- test the interoperability of STEP applications,
- identify critical STEP application area issues, and
- demonstrate the feasibility of STEP-based applications.

What kinds of support are required to operate and maintain the Testbed?

The Testbed and its users require three different kinds of support: technical, administrative, and global systems. Technical staff support includes the preparation of user documentation, help and guidance on the usage of the software, and other forms of assistance. A PDES Hotline has also been established to provide users with an information channel for reporting bugs and resolving other issues pertaining to the use of NIST-developed software. Administrative staff support is required to schedule access to the Testbed, process paperwork, and perform other administrative functions for Testbed users and support staff. Global computing systems staff support is required for the installation, operation, and maintenance of Testbed computers, communications network, and certain general software packages, e.g. computer operating systems.

How do global computing systems staff support the Testbed?

Global computing systems staff are responsible for Testbed computer and communications systems. Without this support, the technical activities of the project could not move forward. Global computing systems must:

- Establish computer accounts for users,
- Configure basic user work environments,
- Manage and assign disk space,
- Administer the network and other communications services,
- Support peripheral devices, e.g. printers and plotters,
- Provide assistance in analyzing requirements and developing plans for upgrades,
- Manage or coordinate the purchase/installation of new systems,
- Coordinate the relocation of installed systems,
- Establish maintenance contracts for installed systems,
- Schedule hardware maintenance and software upgrades,
- Perform backups at scheduled intervals, and
- Provide for repair and/or recovery from system failures.

2.4 Transfer of Product Data Standards Technologies

The staff and facilities of the CALS/PDES Project and the National PDES Testbed have become a valuable national resource. These resources have become a major force in the development of product data standards and related technologies both nationally and internationally. The CALS/PDES Project makes a significant contribution to other organizational efforts through the transfer of product data standards technology from the Testbed to industry, government, and academia.

What types of technology need to be transferred?

The project is both a source and a clearinghouse for the technologies that are being used to develop and implement product data standards. Other organizations and individuals within those organizations will require the following kinds of information and technologies:

- Information about product data specifications and standards,
- Methodologies and techniques for developing and evaluating those standards,
- Software tools for standards evaluation, systems development, and testing,
- Generic requirements analysis, design specifications, and technical plans for implementing systems within their facilities,
- Training courses and associated materials for training staff,
- Prototype application systems which support appropriate standards,
- Conformance testing systems and tools for determining whether systems comply with standards, and
- Information on related technology areas, e.g. distributed data management, information modeling, systems engineering, network communications, and integrated manufacturing systems architectures.

The above list is not exhaustive, but is representative of the types of technology that is transferred by the project.

Who will benefit from the project's technology transfer activities?

NIST has historically had a strong technology transfer program. This program has resulted in close ties between NIST and the staff of many technology-oriented organizations. Some of the beneficiaries of past and future CALS/PDES Project activities include:

- U.S. industry, i.e. private corporations,
- Research institutions and regional technology centers,
- Industrial consortia, e.g. PDES, Inc.,
- Standards committees and supporting organizations, e.g. ISO and IPO,
- Academic institutions, i.e. colleges and universities,
- Government agencies, e.g. DOD, DOE, NASA, and
- Professional societies and technical organizations.

Many organizations will benefit from technology transfer because they are either developers of systems and technology, or they are users of product data systems. Other

organizations are also involved in technology transfer and will further redirect information available from NIST.

How will the project staff conduct technology transfer?

The CALS/PDES Project and the National PDES Testbed will use a diverse set of mechanisms to implement technology transfer. Some examples of the mechanisms which will be used include:

- Publication of papers and technical reports,
- Distribution of public domain software,
- Development of education and training materials,
- Establishment of cooperative industrial research agreements,
- Guest researcher programs with industry,
- Faculty sabbatical and student internship programs,
- Technical presentations and briefings for Testbed visitors,
- Sponsorship of conferences, workshops, and symposia,
- Participation in external events, e.g. exhibitions and demonstrations,
- Direct consultation with other organizations,
- Establishment of on-line electronic access to technical information, and
- Participation on appropriate standards committees, technical task groups, review panels, and interagency management policy boards.

This section has presented background information and an overview of the Management and Technical Support Activities technical thread. The next section outlines the implementation plan for this technical thread in terms of specific tasks.

3 Implementation Plan

One of the principal reasons for establishing the Management and Technical Support Activities thread was to consolidate ongoing or recurring activities within the CALS/PDES Project. The tasks associated with these activities can be divided into four interrelated areas:

- Project management and administration,
- Coordination with external organizations and programs,
- National PDES Testbed operation and maintenance, and
- Technology transfer activities.

The tasks for each of these work areas are performed on either an continuing or "as needed" basis. As such, a schedule for these tasks would not be very revealing.

Regular reports will be developed to report on the activities defined in this plan. Three quarterly reports and one annual report (which includes fourth quarter activities) will be prepared to summarize the activities of this technical thread. The period covered by the annual report will be aligned with the Federal government's fiscal year (October 1 - September 30).

MTS 0 Prepare implementation plan

This document meets this deliverable.

MTS 1 Perform project management and administrative functions

The management and administrative functions include the development of plans, the oversight of technical projects, the implementation of a quality assurance program, and miscellaneous administrative functions that are required to support the overall project.

MTS 1.1 Develop and maintain technical plans for the CALS/PDES Project and National PDES Testbed

Prepare technical plans for the CALS/PDES Project in the appropriate format for the particular plan, i.e. management presentation, technical report, or computerized project management database. Varying levels of plans are required, e.g. high level long range plans and detailed short term plans. Plans will be periodically updated and reprinted, as required.

The project currently requires the following high level conceptual plans in presentation format: "Strategic Plan for Product Data Standards - 10 Year" and "Mechanical Parts Production - 5 Year Plan." The project requires the

following detailed plans in report format: "National PDES Testbed Plan 1990-1991," "Configuration Management Systems and Services," "Validation Testing System," "Application Protocols for Mechanical Parts Production," "STEP Production Cell," "Product Data Exchange Network," "Conformance Testing Service," "Management and Technical Support Activities."

MTS 1.2 Manage and track technical projects

Initiate all required activities which are needed to manage and track technical projects which support the overall product data standards effort. These activities include: 1) review internal project proposals and select and fund projects, 2) organize and staff projects, 3) schedule, execute and track projects, 4) provide management guidance for projects, 5) prepare regular status reports, 6) conduct internal reviews of technical projects and their deliverables, and 7) publish and distribute project results, i.e., deliverables.

The initial set of technical projects (other than Management and Technical Support Activities) are: Configuration Management Systems and Services, Validation Testing System, Application Protocols for Mechanical Parts Production, STEP Production Cell, Product Data Exchange Network, and Conformance Testing Service.

MTS 1.3 Develop quality assurance program for project deliverables

Identify techniques, policies, procedures and mechanisms for ensuring that project deliverables are consistently of high quality. Some examples of project deliverables include: plans for technical programs, technical reports, computer software, testing facilities, evaluations of specifications and/or standards, technical consulting, staff support of other organizations, and various technology transfer activities.

A major component of this task is the development of a program for software quality assurance. The software quality assurance program will implement a software life cycle approach to software development. As part of the life cycle approach the following types of software management documents may be prepared: system requirements specifications, system architectures, interface specifications, detailed designs, test plans, internally documented code listings, maintenance documents for system programmers, and user manuals. The exact set of documents required for any particular system is dependent on the nature of the system and the intended audience for the documents. An internal review process will be

established to verify that all software and document deliverables measure up to quality standards.

MTS 1.4 Perform required administrative functions for the project

Many administrative functions must be performed if the project is to run smoothly. Examples of administrative functions include: 1) conversion of generic plans into actual plans with available resources, 2) establishment and maintenance of budgetary information, 3) initiation of personnel actions for project staff, 4) planning acquisitions and initiation of procurements, 5) management of grants and contracts, 6) establishment of project policies and procedures, 7) initiation of internal work orders for facility modifications, 8) processing of travel requests, and 9) coordination of arrangements associated with guest researchers/industrial loans of equipment and software.

MTS 1.5 Establish Technical Advisory Board for CALS/PDES Project

The project will establish a Technical Advisory Board (TAB) with representatives from government, industry, and academia. The TAB will meet periodically (twice a year) at NIST to review CALS/PDES Project technical efforts. The TAB will offer advice and guidance to project management on industry needs, suggested future directions, etc.

MTS 2 Coordinate with other product data standards activities

Coordinate CALS/PDES Project and National PDES Testbed activities with other organizations involved in the development and implementation of product data standards. The principal organizations which will be supported are: ISO TC184 SC4, IGES/PDES Organization, PDES, Inc., and CALS. Where appropriate, prepare a memorandum of understanding or other working agreement. Identify liaison staff to coordinate joint activities. The typical mode of support for these outside organizations is staff participation on appropriate activities or projects.

MTS 2.1 Participate in ISO STEP development activities

Provide management and technical staff to support the STEP specification development activities underway within the International Organization for Standardization (ISO) TC184 SC4. Assign technical staff to represent U.S. interests in the international standards community. The technical staff that are assigned to this activity will attend appropriate ISO meetings and may perform any or all of the following functions: chair working groups (convenor), serve on US Technical Advisory Group (TAG) to SC4, serve as technical representative or expert for a working group, prepare draft documents, review and vote on draft specifications (STEP parts), prepare position papers for working groups and committees, investigate technical issues, etc. Staff assigned to these roles will be expected to allocate sufficient time to prepare materials for the meetings. Deliverables will include those ISO items developed as a result of National PDES Testbed participation in these activities.

MTS 2.2 Participate in IGES/PDES Organization technical activities

Provide management and technical staff to support the PDES, i.e., "Product Data Exchange Using STEP", activities of the IGES/PDES Organization (IPO). Coordinate activities with IPO Steering Committee. Assign technical staff to represent government interests in the IPO technical organization. The technical staff that are assigned to this activity will attend appropriate IPO meetings and may perform any or all of the following functions: chair committees, serve as technical representative or expert for a committee, prepare draft documents, review and vote on draft specifications (to be submitted as STEP parts), prepare position papers for committees, investigate technical issues, etc. Staff assigned to these roles will require sufficient time to prepare materials for the meetings. The National PDES Testbed will be provided as a resource for IPO projects and committees. Deliverables will include those IPO items developed as a result of National PDES Testbed participation in IPO activities.

MTS 2.3 Participate in PDES, Inc. program

Provide management and technical support staff for appropriate PDES, Inc. programs and activities. Participate in PDES, Inc. management by providing representatives to the Technical Advisory Committee (TAC), Systems Integration Board (SIB), Configuration Control Board (CCB). Provide technical team management and representatives to technical teams, as appropriate. As NIST is a government associate and active participant

in PDES, Inc., a more detailed definition of activities under this task can be found in the joint Memorandum of Understanding and cooperatively-developed technical plans. Deliverables will include those items developed as a result of National PDES Testbed participation in the program.

MTS 2.4 Participate in CALS activities

Provide management and technical support staff for appropriate CALS activities. Some examples of the CALS activities that technical staff may support include: CALS Expo and other CALS Conferences, CALS Industry Steering Group, and the CALS Test Network. Examples of support deliverables provided by NIST staff include: exhibition booths, technical tutorials, technical presentations, contributions to CALS plans, representation at selected meetings, etc.

MTS 2.5 Work cooperatively with other organizations

Initiate cooperative management and technical support activities for other organizations, e.g. other government agencies and private industry. Establish industrial research agreements and guest researcher agreements with industry. Examples of other government agencies and programs which may require support from the project include: Navy Rapid Access to Manufactured Parts (RAMP), Defense Advanced Research Projects Agency (DARPA), Navy-Industry Digital Data Exchange Standards Committee (NIDDESC), Department of Energy (DOE), and National Aeronautics and Space Administration (NASA).

MTS 3 Establish and maintain National PDES Testbed facilities

The National PDES Testbed has been established as a laboratory which is designed to support the validation of STEP specifications and development of prototype software tools and applications. The tasks within this activity satisfy requirements for: 1) computer and communications systems support, 2) a readiness program for user software and facilities, and 3) technical and administrative support for Testbed users. The development of systems and tools for the Testbed are not included in this activity, i.e., these activities are separate technical threads.

MTS 3.1 Provide systems support for computer and communications systems

Install and maintain the computer systems, communications systems, and software which is required to support the project and the Testbed missions.

MTS 3.2 Implement readiness program for Testbed systems and facilities

Identify Testbed user needs. Establish a program which helps ensure that the Testbed systems are stable, reliable, and usable for their intended purpose. This program addresses software, equipment, and other laboratory facilities which are required by these users. Some examples of work areas that are relevant to this program are: specification of user requirements, configuration management of systems, establishment of Testbed policies and procedures, acceptance testing of installed systems, development of appropriate reference materials, and training of Testbed users on systems and procedures.

MTS 3.3 Provide technical and administrative support for Testbed users

Identify and establish mechanisms to provide support for Testbed users. Examples of support areas: provision of database administrator functions, development of introductory user documentation sets, establishment of electronic bulletin boards and news groups, secretarial support for visiting guest researchers using the Testbed, scheduling and coordination of access to Testbed resources, and maintenance of a PDES Hotline to answer questions and resolve problems for users of the Testbed software at remote locations across the nation.

MTS 4 Conduct technology transfer activities

Initiate and conduct various technology transfer activities, e.g. prepare and distribute publications and software, conduct/support workshops and conferences, develop training materials, provide technical consulting, and support exhibitions, demonstrations, etc.

MTS 4.1 Publish reports and distribute information packets

Manage and track project reports through internal review process to printing and distribution. Respond to public requests for information. Assemble packages containing technical reports and other useful information. Establish and maintain a mailing list database. Where appropriate, utilize National Technical Information Service (NTIS) and electronic access facilities established as part of the Configuration Management Systems and Services thread to support dissemination of this information.

MTS 4.2 Conduct and/or support workshops, conferences, and symposia

This task includes both the support of workshops, etc. sponsored by the project and those of other organizations in which project staff participate. Workshops are held to transfer technology both in and out of the project. Workshops and conferences have been already supported for the following organizations: IGES/PDES Organization, PDES, Inc., CALS, Society of Manufacturing Engineers, National Science Foundation, etc.

MTS 4.3 Develop/conduct training programs and tutorials

Support the development of education/training programs for product data standards and related technologies. Provide training for both project staff and representatives of other organizations, e.g. Testbed users. Examples of training and education topics: PDES/STEP overview, Testbed familiarization, use of the tool kits and tools (e.g., Fed-X compiler, QDES part model editor), and Hotline Operator training.

MTS 4.4 Provide consulting support on product data standards

Project staff have expertise on product data standards and related technology areas which is unavailable from any other single source. As such, the project often receives requests to advise and provide consulting support to the Department of Defense, other government agencies, and private industry. Some examples of the subject areas on which project staff have consulted with other organizations include: standards, testing, testbed operations and management, information modeling, database management technology, product data applications, system design and implementation, and program planning. These requests are handled on a case-by-case basis as resources and schedules permit.

MTS 4.5 Support exhibitions, open houses, visits, and demonstrations

These events often provide an opportunity to establish contacts with representatives of other organizations that have interest in product data standards. Some examples of the events that the project supports include: CALS Expo exhibition (annual event), NIST Automation Open House (annual event), NIST Automation Program Briefings and Tours (bi-weekly), PDES, Inc. demonstrations (as scheduled), and IPO/ISO meeting demonstrations (as scheduled). Exhibition booths, posters, presentations, briefing materials, technical handouts, and system demonstrations are examples of the deliverables that are typically prepared for these events.

See Figure 1 for a work breakdown structure of the tasks in the implementation plan. A table of deliverables is provided for these tasks (see Figure 2).

MANAGEMENT AND TECHNICAL SUPPORT ACTIVITIES

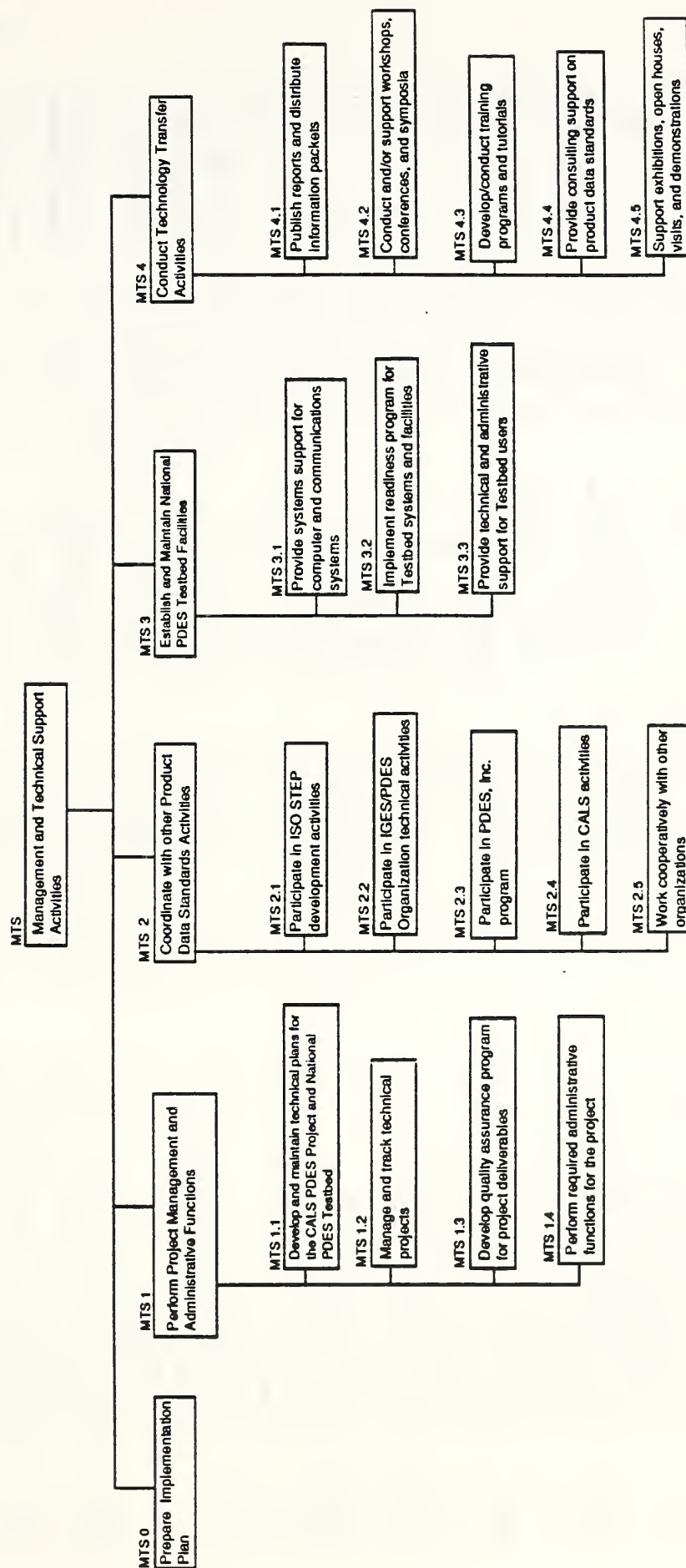


Figure 1. Work Breakdown Structure for Management and Technical Support Activities

PROJECT DELIVERABLES

	TASK	FREQUENCY	DELIVERABLE	SUPPLIER	CUSTOMER
MTS 0	Prepare Implementation plan	Annually	Implementation Plan	MTS	DOD CALS
MTS 1	Perform project management and administrative functions				
MTS 1.1	Develop and maintain technical plans for the CALS/PDES Project and National PDES Testbed	Semi-Annually	Technical Plans	MTS	DOD CALS, Public
MTS 1.2	Manage and track technical projects	Continuous	Quarterly Status Reports	MTS	DOD CALS
MTS 1.3	Develop quality assurance program for project deliverables	Continuous	Overview Memo	MTS	DOD CALS
MTS 1.4	Perform required administrative functions for the project	Continuous	Budgets, Contracts, etc.	MTS	DOD CALS
MTS 1.5	Establish Technical Advisory Board for CALS/PDES Project	Semi-Annually	Board Report	MTS	DOD CALS
MTS 2	Coordinate with other product data standards activities				
MTS 2.1	Participate in ISO STEP development activities	Quarterly	Staff Support	MTS	ISO
MTS 2.2	Participate in IGES/PDES Organization technical activities	Quarterly	Staff Support	MTS	IPO
MTS 2.3	Participate in PDES, Inc. program	As Required	Staff Support	MTS	PDES, Inc.
MTS 2.4	Participate in CALS activities	As Required	Staff Support	MTS	DOD CALS
MTS 2.5	Work cooperatively with other organizations	As Required	Staff Support	MTS	Other Organizations
MTS 3	Establish and maintain National PDES Testbed facilities				
MTS 3.1	Provide systems support for computer and communications systems	Continuous	Testbed Facility	MTS	Testbed Users
MTS 3.2	Implement readiness program for Testbed systems and facilities	Continuous	Overview Memo	MTS	Testbed User Orgs
MTS 3.3	Provide technical and administrative support for Testbed users	Continuous	Testbed Facility	MTS	Testbed Users
MTS 4	Conduct technology transfer activities				
MTS 4.1	Publish reports and distribute information packets	Continuous	Various Publications	MTS	DOD CALS, Public
MTS 4.2	Conduct and/or support workshops, conferences, and symposia	As Required	Workshops, Proceedings	MTS	Workshop Participants
MTS 4.3	Develop/conduct training programs and tutorials	As Required	Training, Materials	MTS	Trainees
MTS 4.4	Provide consulting support on product data standards	As Required	Consultation Service	MTS	Other organizations
MTS 4.5	Support exhibitions, open houses, visits, and demonstrations	As Required	Event participation	MTS	Other organizations

Figure 2. Table of Deliverables for Management and Technical Support Activities

4 Resources

This section provides a brief summary of staff, equipment, software, and facility resources which are required for the Management and Technical Support Activities thread of the CALS/PDES Project.

4.1 Staff

The project is currently staffed by the full-time equivalent of approximately 22 managers, scientists, engineers, technicians, and support personnel. The actual number of staff working on the Testbed is considerably larger. This is due to the fact that some staff work part-time on the project. The total staff is augmented with guest researchers from NIST Industrial Research Associates, students and visiting researchers from academia, and staff working under contract.

Staff resource requirements can be broken down into three major groups which roughly correspond to three of the four major activity areas of the technical plan:

- CALS/PDES management and administrative support team,
- Liaison and support staff for external organizations, and
- National PDES Testbed operation and support staff.

At different times, virtually all project staff support the fourth area, i.e., technology transfer activities. As such, staff members involved in technology transfer activities are not identified as a distinct group. The staff which comprise each of the groups are identified below. A brief summary of individual staff responsibilities is also provided.

CALS/PDES Management and Administrative Support Team - This team is comprised of the overall management and administrative staff of the CALS/PDES Project. It includes CALS/PDES Project Office staff, group leaders, group secretaries, and technical managers. The team operates in a matrix management environment.

CALS/PDES Project Manager - The Manager of the CALS/PDES Project is responsible for the management of the National PDES Testbed and the related CALS/PDES projects.

Project Secretary - The secretary is responsible for performing secretarial functions for the CALS/PDES Project Manager and the CALS/PDES Project Office staff. Responsibilities include: handling routine correspondence, making arrangements for workshops and internal meetings, processing procurements, making travel arrangements for office staff, establishing and maintaining project files, maintaining project schedule, etc.

Resources

Program Coordination Office (PCO) Manager - The PCO Manager is responsible for supporting the CALS/PDES Manager and the project managers in the development and maintenance of project plans and other planning data. The PCO identifies staff training requirements and arranges training programs. The PCO also coordinates a number of technology transfer activities, e.g., participation of the project in external exhibits and demonstrations.

Technical Information Specialist - The specialist is responsible for assisting management and the technical staff in the development of project publications. The specialist authors general project documents, edits other technical reports, and reviews publications for correctness, i.e., appropriate style, document structures, grammar, etc. The specialist may assist project staff in the preparation of technical publications.

Technical Managers - The technical managers are responsible for defining technical objectives, developing plans and scoping level of efforts, determining resource requirements, setting priorities, selecting and assessing the capabilities of team members, matching assignments to team members capabilities, tasking and assisting team members, monitoring progress on tasks, etc. These managers may also monitor the work of project staff that have been assigned to support external organizations.

Liaison and Support Staff for External Organizations - This team includes the managers and the technical staff which are involved in supporting the activities of other major organizations in the product data standards effort.

PDES, Inc. Liaison - The PDES, Inc. Liaison is currently a member of the South Carolina Research Authority (SCRA) staff that has been assigned to work on site at NIST. The Liaison acts as the primary management link between the project and PDES, Inc. The Liaison assists in the development of plans and schedules, arranges joint meetings and workshops, initiates training programs, assists in the planning of demonstrations, visits, and other joint activities. The PDES, Inc. Liaison helps ensure the smooth operation of Testbed and acts as a point of contact for PDES, Inc. technical team leaders and team members.

PDES, Inc. Program Participants - Members of the CALS/PDES Project staff may support the PDES, Inc. program in several ways. They may participate as members of technical teams on projects which are led by PDES, Inc. As technical team members, staff work with representatives from PDES, Inc. member companies. Project staff may also participate in

various management activities either as a team leader or as a member of a PDES, Inc. board or committee, e.g. the Systems Integration Board, Configuration Control Board, or the Technical Advisory Committee.

Standards/Technical Committee Participants - Managers and members of the technical staff may participate in various standards or technical committees. The project sponsors an appropriate level of participation by project staff which is based upon the current funding level. Where appropriate, participants seek guidance, advice, and approval from management (and technical staff) for the positions that are presented in committee meetings.

National PDES Testbed operation and support staff - This team includes all managers and technical staff who are involved in the operation and maintenance of the National PDES Testbed as a user facility.

Testbed Administrator - The Testbed Administrator is responsible for overseeing the day-to-day operations of the Testbed equipment, software and facilities. The Administrator establishes generic work environments on Testbed computer systems, monitors Testbed operations, ensures that systems are working properly to support technical team activities, manages Hotline operations, reviews reported software bugs and their resolution, provides status reports, coordinates installation of new releases of Testbed software, helps establish installation procedures, identifies new equipment and software necessary to support Testbed operations, reviews user documentation for completeness and correctness, and defines requirements for training for Testbed staff/users.

Global Systems Support Personnel - Global systems staff are responsible for providing computer hardware, network communications, and systems software support for the Testbed. The current Testbed computing environment includes Unix workstations, two DEC VMS mainframes, personal computers, and peripheral devices.

Acceptance Testing Team - This team includes technical staff and possibly guest researchers who are responsible for testing and evaluating new software which is to be installed within the Testbed. The team is responsible for conducting acceptance tests on all prototype software to ensure that software operates properly and meets minimum user requirements.

PDES Hotline Operators - Hotline Operators are selected representatives from the technical staff that have a basic understanding of Testbed systems. They provide a phone support service for users of the Testbed systems and the prototype software. They respond to questions about system use, bugs, etc. The operators log the questions that are asked and the problems that are reported. If the operator cannot immediately solve the caller's problem, the operator is responsible for handling the resolution of the problem with an appropriate member of the technical staff.

4.2 Equipment

The computer equipment which is available to the National PDES Testbed includes: two mainframe computer systems, many engineering workstations and personal computers, tape drives, printers, and plotters. Testbed users may access these systems locally, via telephone modems, or over publicly-accessible computer communications networks.

The following computer and communications equipment list identifies not only Testbed systems, but also other laboratory systems, and office computers which are or may be used to support the CALS/PDES Project and the National PDES Testbed.

Computer Systems

Central computing systems and file servers

- 2 VAX clusters (3 servers)
- 6 Sun servers

General purpose networked-workstation environments

- 3 VMS workstations
- 2 DEC workstations
- 65 Sun workstations (21 boot clients)
- 13 personal computers
- 9 networked Apple Macintosh systems

Other supported special purpose computer systems

- 5 Computervision workstations
- 3 Silicon Graphics workstations
- 2 Symbolics
- 2 IBM RT workstations

Network Communications:

- Ethernet
- NISTnet (Internet including NSFnet and SURAnet)
- Applitek broadband
- Serial network
- Appletalk
- Modem Service
- NBSnet
- BITNET
- Usenet

Other supporting equipment which is available to the National PDES Testbed users includes the shop floor systems of the Automated Manufacturing Research Facility (AMRF). The AMRF shop floor contains machine tools, coordinate measuring machines, material handling systems, robots, and production management systems.

4.3 Software

The technical activities of the CALS/PDES Project and the National PDES Testbed require access to a wide variety of computer software applications. The applications must run on the computer systems which were previously identified. The following operating systems environments are and will be supported on those computer systems:

- Sun OS4.0
- VMS 5.2
- Ulrix 3.0
- MS/PC-DOS 3.3
- MacOS (Finder) 6.0

Some of the software packages which are available within these operating system environments include: information modeling systems, data base management systems, computer-aided design systems, graphics tools, program development systems, word processors, and desktop publishing systems. Other software includes prototype testing tools, process planning, and numerically-controlled (NC) programming systems for machine tools.

4.4 Facilities

The Management and Technical Support Activities technical thread of the CALS/PDES Project currently requires the following facilities:

Resources

- Office modules for the staff of the CALS/PDES Project Office,
- Office modules for visiting guest researchers and technical teams,
- Conference room and library areas for management and technical meetings (and the storage of publications and reference materials which require general access),
- Equipment rooms for Testbed computer and communications hardware,
- Testbed laboratory space for technical team testing and development activities, visitor presentations, system demonstrations, and
- Access to AMRF shop floor systems for production testing by technical projects.

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Glossary

Acceptance Testing

Formal testing conducted to determine whether a software system satisfies its acceptance criteria. Formal testing includes the planning and execution of several kinds of tests (e.g., functional, volume, performance tests, etc.) to demonstrate that the implemented software satisfies the customer requirements. This is not part of conformance testing.

AMRF

The Automated Manufacturing Research Facility at the National Institute of Standards and Technology.

ANSI

American National Standards Institute.

Application Protocol (AP)

Part of the STEP specification which deals with how a particular type of application will use STEP. An Application Protocol will specify which STEP resources, i.e. data entities, are relevant to the application and how they are used by an application. The Application Protocol will also establish test criteria and test cases.

CALS

The Department of Defense Computer-aided Acquisition and Logistic Support program.

Certification of Conformance

Third party approval that a product (e.g., a CAD/CAM software package) meets the requirements of a specific standard or technical specification as determined through use of specified test methods.

Configuration Management

Configuration management is the management of change. It is a formal discipline which provides methods and tools to: 1) identify components, versions, and baselines of selected items, and 2) control changes to those items.

Conformance Testing

The testing of a candidate product to determine if it meets the requirements of the standard.

EXPRESS

A specification language for capturing structural and semantic aspects of the STEP information model.

Glossary

Fiscal Year

The budgetary cycle of the U.S. Government which runs from 1 October through 30 September of the following year.

IGES

Initial Graphics Exchange Specification.

IGES/PDES Organization

The U.S. voluntary technical effort which promotes and facilitates the development of IGES and STEP by working with other standards making bodies, for the purpose of developing related specifications into formal standards.

IPO

IGES/PDES Organization.

ISO

International Organization for Standardization.

Life Cycle

The distinct phases in the life of every system or product: requirements analysis, design specification, implementation or production, deployment and maintenance.

NIDDESC

Navy-Industry Digital Data Exchange Standards Committee.

NIST

National Institute of Standards and Technology, formerly the National Bureau of Standards (NBS).

PDES

PDES is the name given to the United States development activity in support of the international standard known as STEP (Standard for the Exchange of Product Model data). Previously PDES and STEP were both used to refer to the developing standard that will enable the interchange of product information throughout a product's life cycle—through design, development, manufacturing and service. Recently in a March 1990 IPO Steering Committee Meeting, the more explicit definition of PDES was made by altering the meaning of the acronym from its earlier meaning of "Product Data Exchange Specification".

PDES, Inc.

A consortium of companies and government organizations which was formed in 1988 with the specific goal of accelerating the implementation of PDES. The program is managed by the South Carolina Research authority and actively seeks new member companies. NIST is a government associate of PDES, Inc.

SCRA

South Carolina Research Authority.

STEP

The informal name which is used to refer to the ISO Standard for the Exchange of Product Model Data.

TAB

Technical Advisory Board.

Testbed

A test environment containing the hardware, instrumentation tools, simulators, and other support software necessary for testing a system or system components.

Validation Testing

The testing process which is directed at evaluating whether the proposed STEP specification is suitable for its intended purpose.

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11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.) <p>The National PDES Testbed is just one small, but critical, component of a larger international effort to develop product data exchange capabilities. As such, Testbed efforts must be coordinated with other organizations. The Management and Technical Support Activities (MTS) thread provides a mechanism under which a variety of activities will take place.</p> <p>This goal of this thread is to establish a focused effort for critical management and technical support activities which will advance the development of product data standards and related technologies. This document provides an implementation plan for the development of management and technical plans for the CALS PDES Project and the National PDES Testbed, coordination and synchronization of activities with other organizations, establishment of stable Testbed facilities and systems, and transfer of product data standards technologies to other organizations.</p>			
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